

Technology as a discipline: A case study

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History and development of Technology as a subject

Technology was introduced as a Leaving Certificate subject in 2007 after several years of development and is now one of four senior cycle technology-based subjects on the curriculum. To the outside observer, its introduction may appear confusing, particularly in the context of three long-established technology-based subjects on the curriculum. This first section aims to outline the background which led to its establishment as a senior cycle subject. In order to outline this its development must be seen in the broader historical context of the provision of technology-based subjects in Irish post-primary schools.

Craft-based subjects originated in the vocational school sector of the 1930s. The vocational school system, established at that time, aimed to provide technical education to those preparing to enter into trades and industry. These schools offered 2-year programmes of study for students. Until the 1960s the vocational schooling system ran independent of the existing secondary education model. However the schools suffered from low levels of participation and low student morale since, instead of being seen as an alternative to the more classical education offered by the secondary school system, they were seen as a poor second, generally attracting those that couldn't enter the secondary school system or those awaiting full time employment (Coochlahan, [1991????](#)). During the 1960s, with the emerging recognition of the importance of education in the context of economic development and coupled with a shift towards a more comprehensive post-primary curriculum, the craft-based subjects of the vocational system became integrated into the secondary curriculum as Intermediate and Leaving Certificate subjects. At the same time, vocational schools were brought into closer alignment with the existing secondary school model through the provision of a more comprehensive curriculum and the opportunity to provide the same programmes of study as the established secondary schools.

The subjects of Metalwork, Woodwork and Mechanical Drawing (once exclusively provided in the vocational schools) became established subjects in the post-primary curriculum throughout the 1970s and 1980s but they remained strongly craft-focused and carried the sex divisions from their initial conceptions.

During the 1980s, influenced by international trends, most notably from the UK, and also as a result of budgetary cutbacks, attempts were made to rationalise the existing provision of Junior level craft-based subjects, namely Woodwork, Metalwork and Mechanical Drawing, into a single subject which would incorporate elements of all three subjects, be hands on and practical in nature, embed new and emerging technologies and erode the material bias inherent in the existing subjects of woodwork and metalwork. While plans were established to introduce a Junior Certificate Technology subject that would in time unify the existing provision, significant resistance to this resulted in the establishment of a new, independent Junior Certificate subject called Technology (McGuinness et al, 1997). Plans were also put

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in place to implement an equivalent senior cycle subject by 1992 yet this did not take place. A review of the new Junior Cycle programme was conducted in ~~1998-1997~~ (9 8 years after its launch). The subsequent report gave an insight into the uptake of the subject and how schools had dealt with its implementation. It noted ~~noting~~ that there ~~was-were~~ significant differences in the provision of resources to teach the subject across the schools examined (McGuinness et al, ~~1997????~~).

With the review of technology education at senior cycle level that begun in the late 1990s a new senior cycle syllabus was developed alongside revised construction Studies, Engineering and Technical Drawing Syllabi. Of the new and revised syllabi the new Design and Communication Graphics (the updated version of the old Technical Drawing syllabus) and the new Technology syllabus were implemented in 2007. The two other new syllabi, Architectural Technology and Engineering Technology (replacements for the old construction studies and engineering subjects), were due to be implemented in 2009 however budget cutbacks, as a result of the current economic conditions, has placed this on hold.

Current role and structure of Technology Education

The subject of technology therefore holds quite a unique place among the subjects offered in the curriculum. As has been highlighted, it was originally designed to unify the existing provision of technology education in schools and to replace the more traditional craft-based subjects but instead it found itself competing against the very subjects it intended to replace and, since its introduction was not favoured by the existing cohort of workshop teachers, its uptake remained relatively low in relation to the existing suite of technology subjects. At a time when the more traditional craft-based subjects could be seen as strange oddities in the system, remnants of a former era, it is the new subject that seems to be the 'odd one out'.

The existing craft-based subjects, having their origins in the vocational schools, had very clear vocational rationales for their existence. The subject of woodwork, and its senior cycle equivalent, Construction Studies, prepared students for apprenticeships in joinery, the building sector or prepared student for related undergraduate programmes at third level. Junior cycle metalwork and its senior cycle equivalent, Engineering, similarly prepared students for trades in fitting, tool making, mechanics and careers in manufacturing. Technical drawing also had a strong vocational focus as its original function was to prepare students for trades in draughting and to compliment the other technology subjects.

The then new technology subject launched in 1980s was a departure from this traditional model. It held no historical ties to existing (or indeed defunct) trades and vocations. Drawing heavily from international trends the subject had at its core an emphasis on design and problem solving, 'The essence of technology is the process of finding a solution to a problem' (Junior Certificate Technology Syllabus, p. 4) and had a clear rationale for the content and structure of the programme. The overall framework outlined in the junior certificate syllabus document sees four fundamental aspects to the study of technology: design and communications, craft skills and knowledge of materials, an understanding of energy and control systems and an awareness and appreciation of the impact of technology on society. These four areas provide the

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knowledge base which the students require in order to engage in the problem-solving activities that are central to the study of Technology;

The central activity in the course is the TASK. The selection of the task will vary according to the stage of development of the student. Every task will require input in terms of knowledge and skills. The interplay between these appropriate resources and suitable tasks is the essence of the course. (Junior Certificate [Technology](#) Syllabus, p. 4)

The new Leaving Certificate subject of Technology continued this overall philosophy claiming that;

[the] Leaving Certificate syllabus has been developed to provide greater progression from the junior cycle and should encourage more students to extend their experience of a technology education throughout their years at post-primary level. Its modular structure allows schools considerable opportunity to build on existing resources and expertise, and should enable more schools to provide a technology education for their students in the senior cycle. ([Leaving Certificate Technology Syllabus, 2006](#), p. 4)

The modular structure consisted of a core common syllabus with five optional elements of which the students are required to study two. Central to the core element of the syllabus is the design process and the major areas of study all support this key element. Areas within the core include project management, materials science, graphics and design, ICT, structures and mechanisms and electronics. The optional elements delve deeper into some aspects of the core of the syllabus, these areas include electronics and control systems, applied control systems, manufacturing systems, materials technology and ICT.

Structure of the subject

Using Becher's classification of academic disciplines the subject of Technology, as it is currently constructed in Irish post-primary educational system, is an applied discipline that draws heavily from hard, as opposed to soft, knowledge. The subject is structured to enable students to acquire a range of technical knowledge and skills (such as materials science, design, electronics and control and manufacturing) and use these in the context of project-based learning activities where the students are provided with design briefs or problems that they must solve. To achieve this goal there appears to be an clear order to the syllabus, as outlined by this quote from one of the course lecturers "*There are certain modules where there is an underlying skills set that has to be obtained before they actually get a problem that's relevant to that area*". In this sense the subject is strongly classified providing a clear order and clearly defined content of what it means to 'do' technology and to be a technologist.

Because we are so tied into the definition of the subject that's out there the skills set that they need to be master at is so well defined that there's quite a large area of essential review that we need to cover that they don't have a lot of choice in. so in terms of picking and choosing different elements in the course I don't think there's anywhere to hide. ([courseCourse](#) lecturer)

Yet on the other hand the nature of the tasks set and the projects undertaken also make it a very open subject. This dichotomy was highlighted by one of the interview respondents who noted that, '*I suppose if you look at it externally it's quite*

nailed down, it's a subject that's very well defined, but yet its not'. This view expressed by one of the programme coordinators is also reflected in the syllabus where it notes that;

In a rapidly changing global society, students need to appreciate that technological capability is necessary and relevant for all aspects of living and working. Many subjects can contribute to the development of a technological capability. ([Leaving Certificate Technology Syllabus, 2006, p. 2](#))

Therefore there appears to be a recognition that technology as a subject does not hold a distinct body of knowledge unique to its area but rather that it uses knowledge from several other disciplines to enable the student to analyse and solve problems. However, the problems set require the student to make an artefact. The subject, as presented to the students, is an intensely practical experience. Indeed the practical process of investigating, planning, designing, making and evaluating solutions to given problems largely defines the subject more so than the technical knowledge required to undertake this process.

Technology is a distinct form of creative activity ... it integrates problem solving and practical skills in the production of useful artefacts and systems. More specifically, the value of technology education comes from the use of the wide variety of abilities required to produce a drawing or make an artefact ... The acquisition of manipulative skills is an important component of this sense of competence and can help to give students a feeling of control of their physical environment. ([Leaving Certificate Technology Syllabus, p. 2](#))

Technology is a doing activity, technologists make things, they solve problems, they invent;

I think it's very well defined ... there's a very specific skills set and knowledge you teach. But in terms of its application I think its wide open, it's not at all defined nor should it be because it's a creative activity. So I think there are certain skills sets that you teach that you need a fundamental understanding of, you know, communication, problem solving, processing. (Interview response)

While the subject is defined by the process that the student engages in, its boundaries with other subjects are significantly blurred. For example, there is considerable overlap between concepts studied in electronics and control elements of the subject with existing subjects such as science and physics. Its links with the hard sciences are also evident in the materials science element of the course where knowledge of chemistry is required to understand material properties and their potential uses in different design solutions. The overlap with the existing science subjects is only at a content level. The applied nature of the existing science subjects relates to experimental work, whereas in Technology the scientific knowledge is used to solve real-life problems and make artefacts. Calculations may need to be made on designed structures to calculate their strength and suitability, knowledge of molecular bonds in materials, their properties, their melting points and optimal working temperatures may be required to select the most appropriate materials to satisfy a design solution. So while its boundaries are blurred it maintains its uniqueness through how it uses the scientific knowledge. In this sense the subject is more defined by how it uses knowledge rather than the knowledge that is studied.

Framing

The process of technological development, and therefore the development of the technologist, is highly framed. The process of technology is seen as a process through which technological problems are investigated, analysed, problems are designed, artefacts manufactured and tested and evaluated for their effectiveness. This framing influences how the subject is taught as the early part of the degree programme focuses on acquiring skills and knowledge required to solve future problems. However, the design process, while appearing to have a logical linear structure, i.e. investigate, plan, design, manufacture and evaluate, attempts to place a simplistic structure on what is a far more complex and non-linear process involving considerable trial and error. This was particularly evident in observations in the workshop where students were manufacturing artefacts. It was not evident that students were working rigidly from pre-designed solutions but instead were arriving at their final solution through a mixture of loosely designed solutions and insights and inspiration gained during the manufacturing stage. Therefore, while the subject frames the technological process as highly sequential, in reality the process is far more haphazard.

Learning how to 'do technology' appears to be as important as learning the technical knowledge and skills needed to design and manufacture solutions. The chief examiner report for 2009 for example noted that students needed greater guidance in planning their work in advance, needed to develop their range of investigative and research skills and the higher order skills of analysis and evaluation. The report also suggested that teachers should, *"provide candidates with frequent opportunities to engage with the design process over the two years of study leading to the examination"*.

Culture of the subject

The culture of the subject is reflected in many ways; the ways of thinking, the ways of acting, the ways of feeling and the sense of belonging to a group. In exploring this aspect several questions arise. Is there a way to think like a technologist? The design process framework, used in the framing of the subject, certainly suggests so. Evident in many of the syllabi documents is the idea of technology as a problem solving process. Technologists are problem solvers and this 'thinking' skill is seen as very important. To think like a technologist also involves being able to critique existing and emerging technologies, such a view sees technology as a literacy, the term technological capability is often used to describe this literacy;

It's almost like learning history or science. What does someone who does History for their Leaving Certificate go on to do? They have an appreciation for what their country is about, where it came from and where its likely to go and to be able to look at something they see in the news and give a critical reading or a critical thought process what they are being shown. Now in technology ... someone who has come through the technology process at Leaving Certificate can pick up the newspaper if they see a report on something in technology or some issue that relates to the planet or the environment that they can look at it critically and say well that makes sense or that doesn't make sense or this person is not talking, not making a cogent

argument. That they would be able to look at stuff and have a knowledge and understanding about how technology works. (Course lecturer 2)

However, while the development of this problem solving skill and technological literacy is important, a critical aspect of technological capability is the ability to manufacture a solution. Therefore the ways of thinking like a technologist must be accompanied by the ways of acting like a technologist. Acting like a technologist fundamentally involves making 'things', it is central to the justification of the syllabus and separates it from other subjects such as science which it shares a significant amount of technical content. Technologists do not simply design or come up with solutions, the making of these solutions is part of 'being' a technologist. But this raises an important question: what is prized more in technology, creativeness/ingenuity or technical competence? It appears that the emphasis on the quality of the manufactured component remains very important. The culture seems to be strongly influenced by the subjects it intended to replace. In [the subjects of metalwork and woodwork engineering](#) the quality of the manufactured component was the most important aspect, this appeared to be the case in technology too. In workshops and graphics laboratories observed students seemed to take great care in the presentation of their work. On one occasion a student brought a piece of scrap metal into the workshop to incorporate into his project and the reaction from the rest of the students appeared to suggest that this was not common practice. The rusty and shabby appearance of the material seemed to amuse the students, suggesting that they had limited experience of using recycled materials and that the use of such material was not a wise decision. In the chief examiner's report for 2009 a recommendation for teachers was to, 'guide students in the process of finishing of the artefact to the highest standard they can achieve' (p. 40). This suggests the aesthetic appearance [and](#) the quality of the finished component is seen as important. Further evidence of this was the presentation of course material and projects on workshop posters which seemed to emphasise the quality of manufacture and neatness of the processes and artefacts.

Is there a way to feel like a technologist? The Leaving Certificate syllabus notes that one of the aims of technology is to enable students to appreciate the impact of technology on society and the environment and to critically judge products from an ethical point of view (Department of Education and Science, 2006). The need to develop these skills is increasingly important and has influenced the design of curricula. Speaking about the development of environmental awareness on the technology education programme a course lecturer noted that, 'you'd find there's a green thread woven through everything nearly'.

The development of an appreciation for good design is also an important outcome. So too is the enjoyment and satisfaction of solving problems;

The satisfaction of successfully solving a problem I think and having ownership of that solution. (Course lecturer 1)

Yes creative activity is at its very essence. I suppose inherent satisfaction that comes with successfully creating something, that's what it is really. (Course lecturer 2)

The process of making artefacts was undoubtedly a motivational experience. Students observed in the workshop labs involved in making projects were highly engaged. It was not uncommon to see students working independently for very long periods without engaging with any classmates. Whereas in other lessons observed, particularly in graphics and electronic labs there was not the same level of interest and enthusiasm from the students.

Implications for ESD

The loose classification of the subject provides significant opportunities for integration of ESD since the subject does not have a tightly defined area of content knowledge. This provides 'space' for elements related to ESD to be included within the content of the programme.

• Technological capability involves a broad understanding of technology and its effects. Again, there are opportunities for greater levels of integration of ESD in this context as students can explore the impact of technology on their lives and explore case studies of technologies affects on a range of ESD related areas such as climate, the environment, human rights and society.

Although the subject encompasses many different areas of content, the subject of technology, as observed in this study, ultimately involves making things. Therefore, there is considerable scope to embed ESD related activities within the setting of design briefs. Carefully selected briefs could raise awareness of important issues and steer pupils to engage in more in-depth investigation of issues.

• The most significant challenge to the integration of ESD within this subject appears to lie in the prevailing culture of the subject since it appears to reinforce the principles and values of an unsustainable economic model of technological development (Gadotti, 2008). Within this culture the subject –often focuses on the solution of problems that appear to have little relevance. Manufactured solutions tend to use materials and processes that have little consideration of their environmental impact and it often presents the development of technology as unproblematic. The future focus should develop pupils' attitudes towards and ways of thinking about technology;

Technology education must involve the exploration of beliefs and values towards technology and the exercise of value judgements ... Design and technology education that fails to recognise the importance of values and attitudes is reduced to technical training. (Martin, 2002, p. 208)

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